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Sexual Process and Genetic Structure of Bacteria

One of the most interesting questions of bacteriology is the problem of the presence or absence of the sexual process in bacteria. Occasionally, the picture of "fusion" of bacterial cells has been observed under the microscope, but the descriptions have not convinced scholars. This "fusion" could be merely mechanical contact without union of cellular bodies or might even have a pathological character, unrelated to sexual multiplication.

Convincing evidence of the presence of the sexual process could come only from the simultaneous combined demonstration of cellular fusion under the microscope together with study of the genetic behavior of the lines arising as a result of such fusion. If an experiment is conducted with strains distinguishable from each other, and forms appear in the progeny combining their properties, then one can speak with certainty of the presence in bacteria of sexual propagation under certain circumstances leading to the development of hybrid individuals.

Thus far only genetic evidence has been given for the sexual process in the bacterium Escherichia coli (1). With mixed cultures of two artificially obtained lines distinguished by their nutritive requirements (one of them required supplementation to the medium of threonine, leucine and thiamine; a second biotin, phenylalanine and cystine), there arose among the progeny a large variety of new forms variously combining the characters of the original lines. Furthermore, there

were discovered the so-called "prototrophs", able to develop on "minimal medium", not requiring any supplementary vitamins or amino acids.

Despite the absence of parallel microscopic observations, even such indirect evidence of hybridization of bacteria offers significant general biological interest. It bears witness to an even broader distribution of sexual propagation than was previously thought, the development of which can be explained only in the light of Darwinism.

In later works (2) further facts were represented on obtaining bacterial hybrids. Experiments were carried out not only with the normal "wild" strain E. coli K-12, growing on minimal medium, but also with changed forms selected from them. These changes include several groups of signs:

(1) Nutritive requirements. The ability is changed for synthesizing supplementary compounds, such as biotin, thiamine, cystine, leucine (actually spelled leucitin - B.D.D.), methionine, proline, threonine and phenylalanine.

(2) The ability to ferment several compounds, lactose and glycerol.

(3) Resistance of the bacteria with respect to certain lines of bacteriophage. Strains were isolated resistant to phages T1 plus T5, only to T1 and to T1 possessing mucoid colonies, and to phage T6.

(4) Resistance of bacteria with respect to several chemical compounds, sodium chloroacetate and sodium azide.

The cultures were grown on full medium containing all the compounds required for their growth. For obtaining the hybrid forms

definite volumes of two cultures were mixed, approximately 10^8 to 10^9 cells in each. Then the study of the isolated lines was carried out on various media which made possible the isolation of different combinations of markers. Special attention was given to the prototrophs in connection with the complexity of the method.

A variety of combinations of markers were obtained: Resistance to any line of phage was connected with various types of nutrition, with the ability or inability to synthesize certain nutritive compounds, with resistance to some chemical compound or absence of such resistance. In this manner a whole series of hybrids were obtained. However, the consequences led further along an incorrect perverse path ("poroshny" is translated by the dictionary as "vicious, depraved or perverse" - B.D.D.). Instead of turning to the study of the conditions of development of bacteria under which they turn to sexual propagation from their usual asexual mode, which would give the possibility to find paths of governing the multiplication of microorganisms, the authors occupy themselves with constructing "genetic charts" with the study of "linkages", etc. Taking the position of the chromosome theory of heredity, the idealistic character of which was uncovered by Soviet geneticist - Michurin, and striving to place his experimental findings on the Procrustean path of hypothesis, Lederberg ignores even the obstacle that bacteria have no chromosomes, and even the presence of a cellular nucleus has not been shown. On the basis of the quantitative relations of various combinations in the hybrid progeny, the distance between genes is determined and a hypothetical chart of genetic structures is traced. In this manner a biological analysis of the events was changed into an

abstractly statistical one and the consequences disappeared into a blind alley.

References

(1) Tatum and Lederberg, Jour. Bact., 1947.

(2) Lederberg, Genetics, 1947.